Electronic Services - Los Angeles
M12683X

Instructions

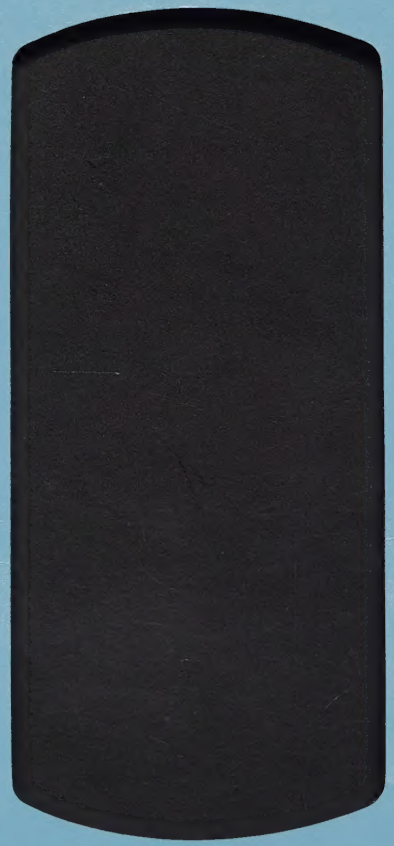
CLOSED CIRCUIT TELEVISION CAMERA 500

TYPE TE-23-A

EBI-6220

MP MASTER
MA32647

GENERAL ELECTRIC



INSTRUCTIONS

CLOSED CIRCUIT TELEVISION CAMERA 500

TYPE TE-23-A

EBI-6220

VISUAL COMMUNICATION PRODUCTS DEPARTMENT
CONSUMER ELECTRONICS DIVISION
GENERAL ELECTRIC COMPANY
ELECTRONICS PARK, SYRACUSE, N.Y.

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EBI-3711 Fundamentals of Television and Essentials of Optics
EBI-3781 Fundamentals of the Vidicon Tube and Transistor Characteristics Resolution Chart

GUIDE TO MODELS

The General Electric Closed Circuit Camera 500, Type TE-23-A, includes the following models:

MODEL 4TE23A1	Standard Camera; operates from standard 60-cycle a-c power and has 75-ohm RF and video outputs.
MODEL 4TE23A2	Similar to Model 4TE23A1, except it is designed for use in video tape recorder applications; includes a crystal-controlled horizontal oscillator (15.750 kHz) to insure optimum Camera and recorder performance by precisely maintaining the synchronization of the two devices.

CLOSED CIRCUIT TELEVISION CAMERA 500

TYPE TE-23-A

INTRODUCTION

The General Electric Closed Circuit Television Camera 500, Type TE-23-A, is designed for a variety of closed circuit television applications. It provides excellent service under all but the most severe environmental conditions.

The Camera may be connected to a standard television monitor or, using an inexpensive 75-ohm to 300-ohm matching transformer, directly to the antenna leads of an ordinary television set. Both monitor and television receiver can be used simultaneously.

The Camera is fully automatic, having no operating controls other than an ON-OFF switch and an optical FOCUS knob. The FOCUS knob allows extreme close-up viewing without the use of close-up lenses or lens adapters. Automatic operation is possible because of precise regulation of internal voltages and the incorporation of automatic light compensation for varying conditions of illumination.

TECHNICAL SUMMARY*

ELECTRICAL

Power Requirement

117 volts a-c, ± 10%, 50/60 Hz, 15 watts.

Vertical Sweep Rate

50 or 60 Hz, nominal.

Horizontal Sweep Rate

15.75 KHz, nominal.

Scanning

Random interlace, 525 lines per frame, 30 frames per second (60 Hz use); 625 lines per frame, 25 frames per second (50 Hz use).

*Complete product specifications are given in G-E publication GEZ-4532.

Type of Sync and Blanking Waveform

Horizontal blanking width 11 microseconds, horizontal sync 4.75 microseconds (nominal values). Sync amplitude 0.4 volt.

Camera Tube Type

G-E A-7199018P1 vidicon.

Sensitivity

Full gray scale and resolution performance.

Resolution

500 lines center, 300 lines corners (video) 300 lines center (RF, limited by television receiver).

Automatic Light Range

Variations of 4000 to 1 in illumination level will produce less than a 2 to 1 change in peak-to-peak output video.

Resolution Stability versus Temperature

No change in resolution over temperature range of 0 to 50 C (32 to 122 F).

Resolution Stability versus Input Voltage Variations

No change in resolution over range of 107 to 127 volts a-c.

Gray Scale

10 shades of gray.

Signal Transmission Distance

Dependent on cable selected.

Video Output

1.4 volts peak-to-peak composite; sync 0.4 volt nominal; polarity black negative; load termination 75 ohms.

RF Output

10 millivolts maximum at 75 ohms. Continuously tunable Channels 2 through 6.

Geometric Distortion

± 3% of picture height (maximum).

MECHANICAL

Dimensions

Length: 11.75 inches (case); 15.75 inches (over-all, including standard lens and cable).
Width: 5.25 inches.
Height: 3.54 inches.

Weight

8 pounds (approximately).

Type of Lens Mount

C-mount, (1-inch-32 thread).

Remote Control

None required.

Camera Mount

Two $\frac{1}{4}$-inch-20 tapped holes in base.

Output Connectors

Type BNC.

ENVIRONMENTAL

Ambient Temperature

0 to 50 C (32 to 122 F) at 95% RH.

Altitude Limits

10,000 feet.

ELECTRICAL CONTROLS

Operating

Power Switch (with indicator light)
Optical Focus Knob

Setup (Recessed Adjustments)*

Target
Beam

*Requires Tool A-7176111P1.

Electrical Focus
TV Channel

INSTALLATION

Carefully unpack the Camera from its carton and inspect it for possible shipping damage. Report any damage to the carrier immediately.

Mount the Camera on the tripod, or other mounting, with a $\frac{1}{4}$-20 mounting screw. Use one of the two tapped $\frac{1}{4}$-20 holes in the base of the Camera (see Fig. 1). One hole is located in the center line of the Camera, the other in the center line of the lens.

Using the Camera cable supplied, interconnect the Camera and the monitor/television receiver. Plug the Camera into a 117-volt a-c outlet.

In video tape recorder applications, using the Model 4TE23A2 Camera, the VIDEO output, 2J1, is connected to the video tape recorder.

The TV output of the Camera, 2J2, may be connected to a 75-ohm coaxial input on a television receiver, or using a matching transformer, to the antenna terminals. All cables are coaxial with Type BNC connectors.

OPERATION

INITIAL OPERATION

The Camera as shipped is adjusted for proper operation under normal conditions of illumination and should normally require no readjustment. Should adjustment be necessary, the procedure outlined below is for the use of qualified service personnel only.

It is assumed that all electrical connections are correct, the lens is in place, and the Camera is plugged into an a-c power source.

CAUTION

NEVER ALLOW AN IMAGE OF THE SUN TO BE FOCUSED ON THE PHOTOCONDUCTIVE LAYER OF THE VIDICON TUBE AT ANY TIME. DO NOT UNDER ANY CIRCUMSTANCE AIM THE CAMERA AT THE SUN WITH POWER ON OR OFF. USE THE DUST CAP SUPPLIED TO COVER THE LENS.

1. Apply power to the Camera by pressing the power switch to the ON position (the red indicator light will light).

2. Adjust the T(arget) control, using the hex end of the alignment tool, to its midrange position. Allow one minute for the vidicon tube to warm up before proceeding.

3. Turn the B(eam) control clockwise until a picture appears on the television receiver/monitor; if necessary, adjust the TV CHANnel control (see below).

4. Adjust the lens focus ring for a sharp picture.

5. Set the f stop on the lens to the lowest value consistent with the depth of field required and the light available.

6. Set the T(arget) control to obtain a 1.4 volt composite output (use an oscilloscope if possible). (If a Type TD-1-B Tape Deck is being used, 1.4 volts video will read in the blue area of the video tape recorder LEVEL meter.)

7. Readjust the B(eam) control, if necessary, to a point just above beam starving. The correct setting of the B(eam) control is that point which provides full detail in scene highlights. As a rule, if the T(arget) control setting is changed, the B(eam) control will require readjustment.

8. Set the TV receiver/monitor contrast and brightness controls for the most pleasing picture.

9. Set the electrical F(ocus) control for the sharpest picture.

TV CHANNEL ADJUSTMENT

The RF output (TV) is adjustable for television reception on Channels 2, 3, 4, 5, or 6. If interference is encountered, or if it is desired to change the channel for any reason, adjust the CHAN(nel) control, using the screwdriver end of the alignment tool, for reception on the desired channel.

TARGET ADJUSTMENT

Adjust the T(arget) control, if necessary, to the point that allows satisfactory operation over the scene brightness range to be encountered. This setting must be determined experimentally. With the Camera aimed at the darkest scene to be viewed, adjust the T(arget) control until a quality picture is obtained. If a quality picture cannot be obtained with the lens iris wide open and the T(arget) control in its maximum clockwise position, more light is required. In general, if the video amplitude holds within a two to one range throughout the light range, the T(arget) setting is correct.

ROUTINE OPERATION

Whenever the Camera is placed in operation, allow for a one-minute warm-up period. This permits the heaters in the vidicon to become stabilized.

Once the preliminary or initial installation adjustments have been made, routine operation of the Camera becomes very much simplified. Large changes in illumination of the scene may require resetting either the lens iris (f/stop) or T(arget) control, always bearing in mind that the B(eam) setting must be readjusted whenever the T(arget) setting is changed.

CAUTION

ADJUSTMENTS OF THE CAMERA AND REPLACEMENT OF THE VIDICON TUBE ARE TO BE MADE ONLY BY QUALIFIED PERSONNEL.

CAMERA FOCUS ADJUSTMENT

It is recommended that the Camera lens focus ring, which is scaled from two feet to infinity, be used for all routine Camera focusing adjustments. The FOCUS knob on the rear panel may be used for extremely close-up focusing adjustments; otherwise it should be set in its zero, or neutral, position, as follows:

1. Set the Resolution Chart, a calendar, or a magazine page at a distance of two feet from the lens.

2. Set the lens focus ring at two feet and, for this adjustment, open the iris to the lowest f/stop number consistent with the light conditions of the room. (This reduces the depth of field, permitting a more accurate positioning of the FOCUS.)

3. Adjust the FOCUS knob for best focus at this point.

CIRCUIT DESCRIPTION

GENERAL

The basic circuit board includes the video, sweep, power, RF modulator, and control sections described below. Refer to the Block Diagram, Fig. 2, and the Schematic Diagram, Fig. 6.

VIDEO SECTION

The video amplifier provides the gain needed to raise the vidicon signal to one volt of video level.

Eight transistors, Q1 through Q8, are used, including the input stage and a d-c clamp, Q6.

No alignment of the video amplifier is required, the only adjustment being that of the STREAKing CONTrol, R18.

Q1 is an emitter follower which presents a high impedance to the vidicon tube. Q2, with R12, R13, R18, and C5, provides the crossover point to compensate for the high-frequency loss in the vidicon tube. Q3 is an emitter follower that provides the necessary matching impedance between Q2 and Q4. Q4 and Q5 provide the final voltage amplification of the signal.

Q6 is fed horizontal and vertical blanking pulses from Q17 to clamp the base of Q7 and thus remove the noise during the blanking period. Q7 and Q8 are the output stage of the video amplifier and transfer the impedance of Q5 to 75 ohms.

SWEEP SECTION

The sweep section provides horizontal and vertical power, as well as blanking and output sync.

1. Vertical Rate

Two transistors, Q15 and Q16, are used as a vertical monostable multivibrator that provides a vertical blanking signal and a drive pulse to the vertical sweep generator. The monostable multivibrator is triggered by the 60-cycle line at 10 volts, which are sustained by the zener diode, CR8. With the input resistance, C34 provides the differentiating circuit to give the triggering pulses.

Two transistors, Q9 and Q10, are used for the vertical sweep circuit, utilizing an integrating amplifier and negative feedback through R40 and C14 to obtain a linear sweep current. The output feeds the vertical deflection coil. The vertical position is controlled by R44, V POS, which varies the d-c current through the vertical deflection coil.

2. Horizontal Rate

Two transistors, Q13 and Q14, are used as a horizontal astable multivibrator that provides a horizontal blanking signal and a drive pulse to the horizontal sweep generator. One branch of the astable multivibrator is controlled by the time constant of C25 and R55. C26 and R54, in series with the variable resistor, R53, H FREQ, controls the other side of the multivibrator to give the horizontal rate.

The Model 4TE23A2 Camera includes a crystal in parallel with C55 in the horizontal astable multivibrator. This crystal (Y1) maintains the frequency stable at 15.750 kHz.

One transistor, Q12, is used for the horizontal sweep that controls the horizontal deflection yoke. Since the horizontal deflection coil has some resistance, the sweep current would rise exponentially instead of linearly. To prevent this, the total Q of the circuit is increased by adding L9 in series with the horizontal coil. Thus the total inductance is almost doubled, but the resistance is increased by only a few percent. The horizontal sweep size is controlled by changing the d-c collector voltage of Q12 by use of the H SIZE control, R48.

C22 resonates with L9 and L3 and the horizontal deflection coil to give a flyback pulse. Horizontal position is controlled by R45, H POS, which varies the d-c current of the horizontal deflection coil.

3. VH Rate

a. Blanking

A single stage is used for blanking, with diodes CR3 and CR4 mixing horizontal and vertical blanking pulses in the base of Q17. The output feeds the video clamp and the cathode of the vidicon tube.

b. Sync

Sync is generated in two mixing stages, Q18 and Q19, that provide proper timing delay for the horizontal sync front porch and the horizontal and vertical back porches. An input pulse from the horizontal frequency generator applies a step of voltage to capacitor C42 and inductor L5. The resulting action is a buildup of voltage across L5 and C42 at a rate controlled by the resonant frequency of L5 and C42. This buildup continues until the voltage present is sufficient to forward-bias the emitter base of Q19 and turn the transistor first into the amplifying region, then into the saturation region.

Transistor Q19 remains turned on until approximately the first half cycle of the input pulse is over. This produces a delay of one to two microseconds in the start of the sync pulse.

An input pulse from the vertical multivibrator is a-c coupled to the base of Q18. The output of the sync is d-c coupled through R33 to the video output and through R34 to the RF modulator.

POWER SECTION

This section provides +12, -12, and +300 volts regulated; and -300 and 6.3 volts a-c unregulated.

The focus coil current is regulated by a transistor, Q24.

CR11 through CR14 form the low-voltage full-wave rectifier. Q22 and Q23 in the series regulation configuration provide the +12 and -12 volts.

CR15 and CR16 form the high-voltage half-wave rectifier. CR7 and CR10 are zener diodes in series that provide the +300 volt regulation.

RF MODULATOR

The RF modulator consists of an oscillator, Q20, with a tank circuit formed by L4, C29, and the trimmer capacitor, C30. The frequency covers the range of television channels 2 through 6.

The output of Q20 is coupled to the base of Q21 by C32. The sync and video feed the emitter through R33 and R34. The output of Q21 is coupled to the output jack by C28.

CONTROL SECTION

Part Z1 includes the Target, Beam, and Focus voltage controls.

The T(arget) hex adjustment controls the voltage of the target of the vidicon across a two-megohm resistor from zero up to 50 volts. Automatic target control is provided through the series regulation of R4 and R5. The higher current drain of high light level scenes causes a greater voltage drop across these resistors,

thus reducing the target voltage. CR1, R1, and R2 limit the target voltage to +95 volts d-c.

The B(eam) adjustment controls the voltage of grid No. 2 of the vidicon across a four-megohm resistor from zero up to 100 volts.

The F(ocus) adjustment controls the voltage of pin 6 of the vidicon across a three-megohm resistor from 100 up to 200 volts.

MAINTENANCE

GENERAL

All maintenance, including removal and replacement of the vidicon tube, internal adjustments, and servicing must be referred to qualified service personnel.

LENSES

Exercise care when cleaning coated lenses, since they are easily scratched. Use the following procedure for cleaning:

1. Slightly moisten a lens cleaning tissue, or other similar material, with isopropyl alcohol and wipe the lens, using a light pressure.

2. Use a soft camel hair brush when the lens is subject to dust only. Tape the metal ferrule on the brush to prevent accidental scratching of the surface of the lens.

TROUBLESHOOTING

The following are the more common difficulties and faults that may arise in the operation of the Camera:

Trouble	Remedy
Camera will not operate (pilot lamp does not light).	Check the Camera $\frac{1}{2}$-ampere fuse (2F1).
Pilot lamp lights but there is no picture output.	Check the B(eam) and T(arget) control settings.
Low contrast picture.	Open the lens iris. Advance the Camera T(arget) control. Provide more scene illumination.
Lack of picture detail.	Clean the lens and the front of the vidicon tube. Focus optically at the lens. Focus the electrical F(ocus) control.

Trouble	Remedy
	Turn down the Camera T(arget) and receiver contrast controls (picture was overloading the receiver). Turn down the B(eam) control.
Picture will not lock horizontally.	Check the cable from the Camera to the monitor/receiver for open or short. Adjust R53 H FREQ control on board. Check the horizontal frequency.
Streaking.	Adjust the Camera STREAK CONTrol, R18, until no black or white trailing appears at an edge.
Picture blooms.	Make certain that the video cable is properly terminated.

REMOVING THE VIDICON TUBE

1. Disconnect the Camera cable and the power plug.

2. Remove the Camera cover by loosening the two captive screw fasteners in the base of the Camera.

WARNING

DISCHARGE THE POSITIVE HIGH-VOLTAGE SUPPLY TO GROUND, USING THE BLADE OF A SCREWDRIVER TO SHORT OUT FILTER CAPACITOR C53. THIS MUST ALWAYS BE DONE AFTER THE CAMERA HAS BEEN DISCONNECTED AND THE COVER REMOVED.

3. Remove the lens.

4. Using the special spanner wrench, A-7167210G3, unscrew the lens holder, using the two small holes in the holder to engage the wrench.

5. Unplug the vidicon socket.

6. Loosen the tube clamp on the rear of the vidicon deflection yoke.

7. Carefully extract the vidicon from the front of the Camera.

REPLACING THE VIDICON TUBE

In general, the replacement of the vidicon is the reverse of the procedure for its removal.

1. Be sure to insert the vidicon so that its pins locate properly in the tube socket. The index (short) pin of the tube must line up with the tube socket hole with the screw in it.

2. Rotate the entire tube assembly until the index pin is in the 9 o'clock position when viewed from the front of the Camera. Seat the vidicon firmly in the yoke.

3. Tighten the tube clamp on the rear of the vidicon deflection yoke just enough to secure the tube. DO NOT OVERTIGHTEN.

4. Replace and secure the Camera cover with the captive screw fasteners.

ALIGNING THE DEFLECTION COIL

1. Loosen the two #10-32 screws on the horizontal centerline of the tube at the rear of the yoke.

2. Loosen the tube clamp.

3. Grasp the protruding end of the deflection coil and rotate it until the scene becomes correctly oriented on the Monitor.

4. Retighten the screws that were loosened at steps 1 and 2.

INTERNAL ADJUSTMENT CRITERIA

Control	Symbol	Adjustment
H FREQ	R53	Adjust from the low-frequency end of the control to 15.750 kHz. Model 4TE23A2 only: Increase from the low end of the control until the crystal takes over; note the position of the control. Keep increasing until the frequency starts to increase once more; note this position. From the low end, set the control midway between the two positions noted.
H SIZE	R48	Adjust to obtain a 4:3 ratio of horizontal to vertical size.
V POS H POS	R44 R45	Adjust to center the picture vertically and horizontally.
STREAK CONT	R18	Observe any vertical edge in the scene on the Monitor and adjust R18 to eliminate any trailing white or black lines.
Alignment Rings at Rear of Yoke		Adjustment is the same as steps 3a, b, and c, in the Camera and Sweep Adjustment section (below).

CAMERA AND SWEEP ADJUSTMENT

NOTE

Set the B(eam) control fully counterclockwise and allow the Camera a 15-minute warmup before attempting to adjust the sweep circuits.

1. Position the Resolution Chart (located in the back of this book) on a wall or other convenient support facing the Camera. The center of the Chart must be along the axis of the lens at a distance from the front of the Camera given in the following table for a 9 x 12 inch chart. (For a smaller chart, the distance must be correspondingly reduced.) Set the lens focus to the chart-to-Camera distance.

CHART-TO-CAMERA DISTANCE TABLE

Lens	Distance
12.5 mm	12 inches
25 mm	24 inches
50 mm	48 inches
75 mm	72 inches
100 mm	96 inches

2. On a suitable television monitor, reduce the H and V Size controls until the entire monitor raster, including the corners, is visible. Set mechanical FOCUS knob on the Camera for the sharpest picture.

3. Adjust the magnetic beam centering alignment by rotating the two ring magnets on the rear of the yoke assembly.

a. Start with both square tabs at the 12:00 o'clock position, viewed from the front of the Camera.

b. Next, rotate the rear ring so that the square is at the 6:00 o'clock position. Now the magnets cancel each other and their combined effect is minimal.

c. Readjust the F(ocus) and then rotate rings relative to each other while viewing the monitor to obtain proper magnetic centering. When properly set, the center of the chart should appear to rotate about a fixed point as the electrical F(ocus) control is readjusted. Set the electrical F(ocus) for the sharpest picture.

d. Set the mechanical FOCUS knob for the sharpest picture.

4. Adjust the POSition and SIZE controls so that the Chart just fills the raster. (When using an EIA Resolution Chart, note the small white wedge-shaped indicators on the edge of the Chart. When these arrows touch the edges of the raster, size and centering are properly set.)

Touch up the Horizontal SIZE control for optimum center pattern reproduction.

5. Expand the monitor presentation back to its normal size.

CIRCUIT BOARD REMOVAL

WARNING

BEFORE REMOVING THE CIRCUIT BOARD, DISCHARGE THE POSITIVE HIGH-VOLTAGE SUPPLY TO GROUND, USING THE BLADE OF A SCREWDRIVER TO SHORT OUT FILTER CAPACITOR C53. THIS MUST ALWAYS BE DONE AFTER THE CAMERA HAS BEEN DISCONNECTED AND THE COVER REMOVED.

The circuit board is secured by three ground clips screwed into the Camera casting. Before loosening the three Phillips head screws, disconnect the target lead wire from the board.

Although the circuit board is designed to be extremely rugged when mounted as an integral part of the Camera, great care must be exercised in handling it when removed. Parts may be damaged, for example, by placing the board component-side down and inadvertently placing another object on it.

CAUTION

WHEN REPLACING THE BOARD, TIGHTEN THE MOUNTING SCREWS FIRMLY TO INSURE PROPER CAMERA OPERATION; LOOSE MOUNTING SCREWS MAY CAUSE VIDEO OSCILLATION.

COMPONENT BOARD SERVICE NOTES

The following will be of aid when replacing components on the circuit board. Use only a 25- or 35-watt soldering iron to service the board, since excessive heat can damage wiring and components.

CAUTION

DO NOT USE A LARGE SOLDERING IRON TO SERVICE THE BOARD.
DO NOT REMOVE A TRANSISTOR FROM ITS MOUNTING FACILITY WHILE POWER IS APPLIED; TO DO SO MAY PERMANENTLY DAMAGE THE TRANSISTOR.

1. Grip the component to be removed at one end with long-nose pliers, then apply a narrow-tip soldering iron to the component lead, barely touching the board wiring. While the solder joint melts, lightly pull with the pliers until the lead can be pulled free of the board. Free the other lead in the same manner.

2. When a component is removed, it should be replaced with a new component of the same value. When installing the new component, observe the length and dress of the leads on the old component, then cut and bend the leads of the new component in the same way.

3. Place the leads in the holes. If residual solder prevents a lead from entering the hole, very gently ream out the solder with a sharply pointed, square awl. Then place the leads in the holes so that the component is held in place by friction or slight spring tension of the leads.

4. Using a high grade rosin core electrical solder, apply the soldering iron tip, then apply the solder to the junction of the hole, so that a very small amount of solder flows around the lead and into the hole, bonding the lead to the board.

5. Examine the joint carefully. A good solder joint should withstand a light pull by the fingers. Clear away any loose solder, making sure that no scraps fall where they might cause a short.

TROUBLE SHOOTING TRANSISTOR CIRCUITS

The trouble-shooting techniques described in EBI-3781, included as an insert in this book, are applicable to the TE-23-A Camera.

Refer also to the typical waveforms, Figs. 3 and 4. These were taken with a Tektronix Type 535 Oscilloscope.

TESTING TRANSISTORS

Refer to EBI-3781.

PARTS REPLACEMENT

The Parts List for the electrical components immediately follows this section. Component locations are shown in Fig. 5.

If a component requires replacement, obtain its description from the Parts List and the part from a local distributor. When a special part is not available locally, order it by G-E Drawing number (found in the Parts List), addressing the order to the General Electric Company, Visual Communication Products Department, Service Parts, Building 7, Room 321, Electronics Park, Syracuse, New York, 13201.

PARTS LIST

Symbol	Description	G-E Drawing
	CAPACITORS	
1C1	Ceramic, Hi-K disk; 0.005 mfd +80% -20%, 50 v d-c w. Sprague Cat. #40C141.	B-7491827-P1
1C2	Ceramic, Hi-K disk; 50,000 mmfd +80% -20%, 600 v d-c w.	B-7493821-P19
1C3	Ceramic, Hi-K disk; 0.02 mfd +80% -20%, 450 v d-c w. Centralab Type DA-145.	B-7488160-P2
	CONNECTOR	
1J1	18 positions. AMP Inc. Part #582387-9.	B-7498003-P2
	INDUCTOR	
1L1	Vidicon yoke.	C-7782088-P1
	RESISTOR	
1R1	Composition; 0.43 megohm ± 5%, $\frac{1}{4}$ w.	C-3R152-P434J
	TRANSFORMER	
1T1	Power, single phase. Pri: 120 v, 50/60 cycles; sec #1: 320 v d-c, 0.005 amp; sec #2: 18 v d-c, 0.2 amp; sec #3: 6.3 v a-c, 0.6 amp.	B-7499746-P1
	TUBE	
1V1	Vidicon tube.	A-7199018-P1
	TUBE SOCKET	
1XV1	For small-button ditetrar 8 pin base tubes, mica filled phenolic. Cinch Cat. #54A18088.	A-7143125-P1

Symbol	Description	G-E Drawing
	BACK PANEL PL-7699803G2	
	CAPACITOR	
2C1	Ceramic, Hi-K disk; 0.01 mfd +100% -0%, 500 v d-c w.	C-7774750-P13
	FUSE	
2F1	Pigtail type, slow blow; ½ amp at 250 v. Bussman Type MDV.	B-7498196-P6
	INDICATOR LIGHT	
2I1	Neon, white body, red lens, 115 v a-c. Lee-Craft Type 36N2311.	B-7499752-P1
	CONNECTORS	
2J1 and 2J2	Bulkhead receptacles. MIL Type UG-1094/U.	C-7776570-P17
	INDUCTORS	
2L1 and 2L2	Chokes. National Radio Co. Cat. #R45-254.	B-7496805-P10
	PLUG	
2P3	Power cord with plug, General Insulated #G1-P3 or Royal Electric #P-5.	C-7777121-P10
	SWITCH	
2S1	Rocker switch; spdt, white rocker.	C-7782128-P2

Symbol	Description	G-E Drawing
	CAMERA BOARD PL-7699806G1,2	
	CAPACITORS (Aluminum, electrolytic, +150% -10%, 25 v d-c w, unless otherwise specified.)	
C1	0.047 mfd ± 20%, 600 v d-c w. G-E Type 75F6R6B473.	C-7782062-P611
C2	100 mfd, 10 v d-c w. Matsushita Electric Part #ECE-A-10V-100.	C-7781881-P12
C3	Silver mica, epoxy dipped; 220 pf ± 10%, 500 v d-c w. Electromotive Type DM15.	B-7489162-P135
C4	100 mfd, 10 v d-c w. Matsushita Electric Part #ECE-A-10V-100.	C-7781881-P12
C5	Silver mica, epoxy dipped; 270 pf ± 10%, 500 v d-c w. Electromotive Type DM15.	B-7496931-P137
C6	100 mfd, 10 v d-c w. Matsushita Electric Part #ECE-A-10V-100.	C-7781881-P12
C7	10 mfd, 15 v d-c w. Matsushita Electric Part #ECE-A-15V-10.	C-7781881-P14
C8	Ceramic, Hi-K disk; 1800 pf ± 10%, 1000 v d-c w.	B-7493821-P20
C10	500 mfd, 3 v d-c w. Matsushita Electric Part #ECE-A-3V-500.	C-7781881-P15
C11	100 mfd, 10 v d-c w. Matsushita Electric Part #ECE-A-10V-100.	C-7781881-P12
C12	Silver mica, epoxy dipped; 150 pf ± 10%, 500 v d-c w. Electromotive Type DM15.	B-7496931-P131
C13	100 mfd, 10 v d-c w. Matsushita Electric Part #ECE-A-10V-100.	C-7781881-P12
C14 and C15	Electrolytic, solid tantalum type; 0.68 mfd ± 20%, 35 v d-c w. Texas Instrument Type SCM684FP035C4, Sprague Type 150D154X0035A2.	B-7493471-P24
C16	200 mfd. Matsushita Electric Part #ECE-A-25V-200.	C-7781881-P10

Symbol	Description	G-E Drawing
	CAPACITORS (CONTINUED) (Aluminum, electrolytic, +150% -10%, 25 v d-c w, unless otherwise specified.)	
C17	Ceramic, Hi-K disk; 0.005 mfd +80% -20%, 50 v d-c w. Sprague Cat. #40C141.	B-7491827-P1
C21	50 mfd. Matsushita Electric Part #ECE-A-25V-50.	C-7781881-P4
C22	Polyester, tubular; 0.0047 mfd ± 5%, 100 v d-c w. G-E Type 61F.	B-5491656-P46
C23	10 mfd, 15 v d-c w. Matsushita Electric Part #ECE-A-15V-10.	C-7781881-P14
C24	0.10 mfd ± 20%, 50 v d-c w. G-E Type 75F2R5B104.	C-7782062-P13
C25 and C26	Polyester, tubular; 0.0022 mfd ± 5%, 100 v d-c w. G-E Type 61F.	B-5491656-P27
C27	Ceramic, Hi-K disk; 0.005 mfd +80% -20%, 50 v d-c w. Sprague Cat. #40C141.	B-7491827-P1
C28	Silver mica, epoxy dipped; 220 pf ± 10%, 500 v d-c w. Electromotive Type DM15.	B-7496931-P135
C29	Ceramic, disk type, temp compensating; 8.0 pf ± 0.5 pf, 500 v d-c w, zero (NPO) temp coef.	C-7774846-P8
C30	Variable, ceramic; 9 to 50 pf -100% +0% min, -0% +50% max, -750 temp coef. Erie Part #3192-000.	B-7493393-P205
C31	Ceramic, Hi-K disk; 0.005 mfd +80% -20%, 50 v d-c w. Sprague Cat. #40C141.	B-7491827-P1
C32	Ceramic, disk type, temp compensating; 5.0 pf ± 0.5 pf, 500 v d-c w, zero (NPO) temp coef.	C-7774846-P5
C33	Ceramic, disk type, temp compensating; 33 pf ± 10%, 500 v d-c w, zero (NPO) temp coef.	C-7774846-P15
C34	Polyester, tubular; 0.01 mfd ± 5%, 100 v d-c w. G-E Type 61F.	B-5491656-P14
C35	Polyester, tubular; 0.022 mfd +5%, 100 v d-c w. G-E Type 61F.	B-5491656-P18

Symbol	Description	G-E Drawing
	CAPACITORS (CONTINUED) (Aluminum, electrolytic, +150% -10%, 25 v d-c w, unless otherwise specified.)	
C36	Silver mica, epoxy dipped; 82 pf ± 10%, 500 v d-c w. Electromotive Type DM15.	B-7496931-P125
C37	Ceramic, Hi-K disk; 0.01 mfd +80% -30%, 50 v d-c w. Sprague Cat. #19C180.	B-7491827-P2
C38	50 mfd. Matsushita Electric Part #ECE-A-25V-50.	C-7781881-P4
C40	Ceramic, Hi-K disk; 0.005 mfd +80% -20%, 50 v d-c w. Sprague Cat. #40C141.	B-7491827-P1
C41	Ceramic, Hi-K disk; 0.1 mfd +80% -30%, 50 v d-c w. Sprague Cat. #36C172.	B-7491827-P5
C42	Silver mica, epoxy dipped; 680 pf ± 5%, 300 v d-c w. Electromotive Type DM15.	B-7496931-P46
C45	10 mfd, 15 v d-c w. Matsushita Electric Part #ECE-A-15V-10.	C-7781881-P14
C46	50 mfd. Matsushita Electric Part #ECE-A-25V-50.	C-7781881-P4
C47	200 mfd. Matsushita Electric Part #ECE-A-25V-200.	C-7781881-P10
C50	10 mfd, 15 v d-c w. Matsushita Electric Part #ECE-A-15V-10.	C-7781881-P14
C51	50 mfd. Matsushita Electric Part #ECE-A-25V-50.	C-7781881-P4
C52	200 mfd. Matsushita Electric Part #ECE-A-25V-200.	C-7781881-P10
C53 and C54	5.0 mfd, 450 v d-c w. Matsushita Electric Part #ECE-A-450V-5.	C-7781881-P13
C55	Silver mica, epoxy dipped; 27 pf ± 10%, 500 v d-c w. Electromotive Type DM15. (Model 4TE23A2 only.).	B-7496931-P113
C57 and C58	Ceramic, Hi-K disk; 0.01 mfd +100% -0%, 500 v d-c w.	C-7774750-P13

Symbol	Description	G-E Drawing
	CAPACITORS (CONTINUED) (Aluminum, electrolytic, +150% -10%, 25 v d-c w, unless otherwise specified.)	
C59	Ceramic, disk type, temp compensating; 22 pf ± 5%, 500 v d-c w, -80 temp coef.	C-7774846-P247
C60	Ceramic, disk type, temp compensating; 10 pf ± 0.5 pf, 500 v d-c w, -80 temp coef.	C-7774846-P210
	RECTIFIERS	
CR1	Silicon diode; 175 max PIV a-c or steady state d-c. Hughes Type 1N459.	C-5494922-P4
CR2	Germanium rectifier; 100 PIV max. G-E Type 1N91.	C-7777654-P1
CR3 and CR4	Germanium diodes; 125 PIV. Nucleonic Products, Sylvania, Transitron, General Instrument or Hughes Type 1N277.	A-7164424-P164
CR5 and CR6	Zener diodes; 13 v ± 5%.	A-7172767-P147
CR7	Zener diode; 150 v ± 10%. Power Components Type TZ150.	A-7172767-P48
CR8	Zener diode; 9.0 v min to 11.2 v max. G-E Type A-525 or A-525-2.	B-7499649-P1
CR9	G-E Type 1N4454.	A-7164424-P104
CR10	Zener diode; 150 v ± 10%. Power Components Type TZ150.	A-7172767-P48
CR11 thru CR14	Silicon rectifiers; 50 PIV. Power Components Type CL05.	A-7164424-P162
CR15 and CR16	Silicon rectifiers; 800 PIV. Power Components Type CL-8, Sarkes-Tarzian Type F8.	A-7164424-P163
CR17	G-E Type 1N4454.	A-7164424-P104

Symbol	Description	G-E Drawing
	INDUCTORS	
L2 and L3	Inductance 10,000 uh ± 10%, d-c resistance 75 ohms max. Aladdin Part #22-105.	B-7493492-P2
L4	Inductance 0.175 uh ± 10%.	A-7199008-P1
L5	Inductance 10,000 uh ± 10%, d-c resistance 75 ohms max. Aladdin Part #22-105.	B-7493492-P2
L9	Inductance 0.75 mh ± 10%, d-c resistance 0.6 ohm +0.1 -0.3 ohm. Penn-Trann Corp. Type 895.	B-7499813-P1
L10	RF coil; 2.7 uh ± 10%, d-c resistance 1.2 ohms max. Jeffers Cat. #4411-13.	B-7498929-P9
	TRANSISTORS	
Q1 and Q2	Fairchild Type 2N3563.	A-7164451-P196
Q3 and Q4	Fairchild Type 2N3646.	A-7164451-P195
Q5	Texas Instrument Type TIXM201.	A-7164451-P214
Q6 thru Q8	Fairchild Type 2N3646.	A-7164451-P195
Q9 and Q10	G-E Type 2N3415.	A-7164451-P213
Q12	Fairchild Type 2N3643.	A-7164451-P212
Q13 thru Q16	G-E Type 2N3415.	A-7164451-P213
Q17	Fairchild Type 2N3638.	A-7164451-P184
Q18 and Q19	G-E Type 2N3415.	A-7164451-P213

Symbol	Description	G-E Drawing
	TRANSISTORS (CONTINUED)	
Q20	Fairchild Type 2N3563.	A-7164451-P196
Q21	Fairchild Type 2N3646.	A-7164451-P195
Q22	RCA Type 40324.	A-7164451-P217
Q23	RCA Type 40022.	A-7164451-P215
Q24	RCA Type 40323.	A-7164451-P216
	RESISTORS (Composition, ± 5%, $\frac{1}{4}$ w, unless otherwise specified.)	
R1	2.2 megohm.	C-3R152-P225J
R2	0.51 megohm.	C-3R152-P514J
R3	2200 ohms.	C-3R152-P222J
R4	10.0 megohm.	C-3R152-P106J
R5	Composition; 2000 megohm ± 20%, $\frac{1}{2}$ w.	C-3R77AA-P208
R6	0.10 megohm.	C-3R152-P104J
R7	51,000 ohms.	C-3R152-P513J
R10	3000 ohms.	C-3R152-P302J
R11	1500 ohms.	C-3R152-P152J
R12	3000 ohms.	C-3R152-P302J
R13	5100 ohms.	C-3R152-P512J
R14	3900 ohms.	C-3R152-P392J
R15	4300 ohms.	C-3R152-P432J
R16	2200 ohms.	C-3R152-P222J
R17	3000 ohms.	C-3R152-P302J
R18	Potentiometer, carbon film; 100,000 ohms ± 30%, 1/8 w. CTS Type X201.	B-7497175-P11

Symbol	Description	G-E Drawing
	RESISTORS (CONTINUED) (Composition, ± 5%, $\frac{1}{4}$ w, unless otherwise specified.)	
R20	2400 ohms.	C-3R152-P242J
R21 and R22	2000 ohms.	C-3R152-P202J
R23	5100 ohms.	C-3R152-P512J
R24	15 ohms.	C-3R152-P150J
R25	680 ohms.	C-3R152-P681J
R26	20,000 ohms.	C-3R152-P203J
R27	3000 ohms.	C-3R152-P302J
R30	3900 ohms.	C-3R152-P392J
R31	15,000 ohms.	C-3R152-P153J
R32	68 ohms.	C-3R152-P680J
R33	2400 ohms.	C-3R152-P242J
R34	6800 ohms.	C-3R152-P682J
R35	62,000 ohms.	C-3R152-P623J
R36	22,000 ohms.	C-3R152-P223J
R37	620 ohms.	C-3R152-P621J
R40	560 ohms.	C-3R152-P561J
R41	68 ohms.	C-3R152-P680J
R42	1000 ohms, 1 w.	C-3R78-P102J
R43	1300 ohms.	C-3R152-P132J
R44 and R45	Potentiometer, carbon film; 5000 ohms ± 30%, 1/8 w. CTS Type X201.	B-7497175-P6
R46	270 ohms.	C-3R152-P271J

Symbol	Description	G-E Drawing
	RESISTORS (CONTINUED) (Composition, ± 5%, $\frac{1}{4}$ w, unless otherwise specified.)	
R48	Potentiometer, carbon film; 500 ohms ± 30%, 1/8 w. CTS Type X201.	B-7497175-P2
R49	100 ohms.	C-3R152-P101J
R50	24,000 ohms.	C-3R152-P243J
R51	200 ohms.	C-3R152-P201J
R52	300 ohms.	C-3R152-P301J
R53	Potentiometer, carbon film; 15,000 ohms ± 30%, 1/8 w. CTS Type X201.	B-7497175-P9
R54	Precision; 71,500 ohms ± 1%, $\frac{1}{4}$ w.	C-3R166-P7152
R55	Precision; 20,000 ohms ± 1%, $\frac{1}{4}$ w.	C-3R166-P2002
R56	200 ohms.	C-3R152-P201J
R57	300 ohms.	C-3R152-P301J
R60	10,000 ohms.	C-3R152-P103J
R61	1000 ohms.	C-3R152-P102J
R62	3300 ohms.	C-3R152-P332J
R63	360 ohms.	C-3R152-P361J
R64	39,000 ohms.	C-3R152-P393J
R65	3000 ohms.	C-3R152-P302J
R66	10 ohms.	C-3R152-P100J
R67	150 ohms.	C-3R152-P151J
R70	0.18 megohm, 1 w.	C-3R78-P184J
R71	0.13 megohm. (Model 4TE23A1 only.).	C-3R152-P134J
R71	0.13 megohm. (Model 4TE23A2 only.).	C-3R152-P134J
R72	1800 ohms.	C-3R152-P182J

Symbol	Description	G-E Drawing
	RESISTORS (CONTINUED) (Composition, ± 5%, $\frac{1}{4}$ w, unless otherwise specified.)	
R73	27,000 ohms.	C-3R152-P273J
R74	390 ohms.	C-3R152-P391J
R75	620 ohms.	C-3R152-P621J
R76	10,000 ohms.	C-3R152-P103J
R77	16,000 ohms.	C-3R152-P163J
R80 and R81	2000 ohms.	C-3R152-P202J
R82	10,000 ohms.	C-3R152-P103J
R83	12,000 ohms.	C-3R152-P123J
R84	0.10 megohm.	C-3R152-P104J
R85	12,000 ohms.	C-3R152-P123J
R86	15,000 ohms.	C-3R152-P153J
R96 and R97	200 ohms.	C-3R152-P201J
R100	Precision, wirewound; 330 ohms ± 1%, 2.5 w.	C-7778027-P132
R101 and R102	200 ohms.	C-3R152-P201J
R103	5100 ohms.	C-3R152-P512J
R105	0.20 megohm.	C-3R152-P204J
R108	220 ohms.	C-3R152-P221J
R109	47,000 ohms.	C-3R152-P473J
R110	470 ohms.	C-3R152-P471J
R111	1000 ohms.	C-3R152-P102J

Symbol	Description	G-E Drawing
	CRYSTAL	
Y1	Frequency 15.75 kc. (Model 4TE23A2 only.).	B-7499796-P1
	RESISTOR NETWORK	
Z1	Resistor network. Centralab Type 70-3. Includes: Potentiometers rated 1 megohm. (Qty. 2). Potentiometer rated 2 megohm. Resistor rated 3 megohm. Resistor rated 2 megohm. Resistor rated 0.5 megohm.	C-7782043-P1

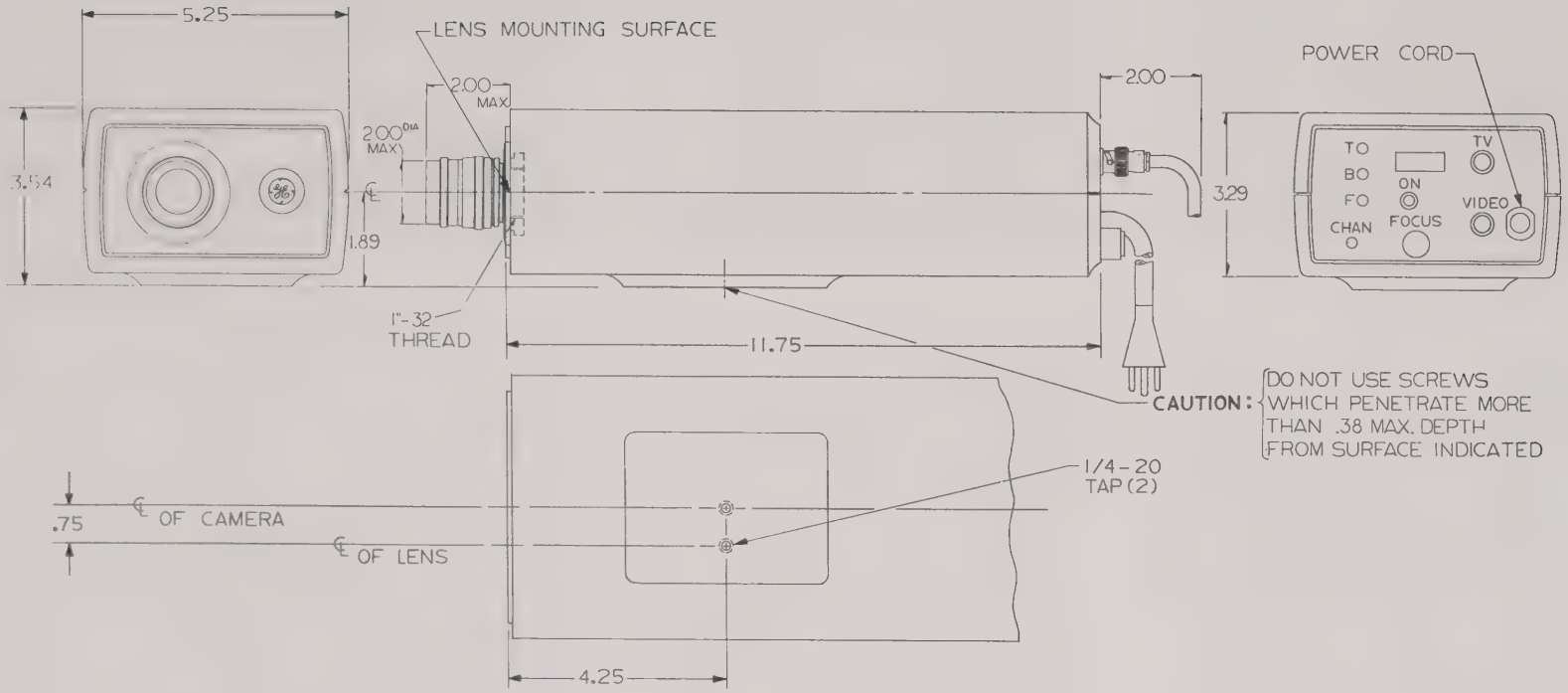


Fig. 1 Outline Drawing (D-7699814)

EBI-6220

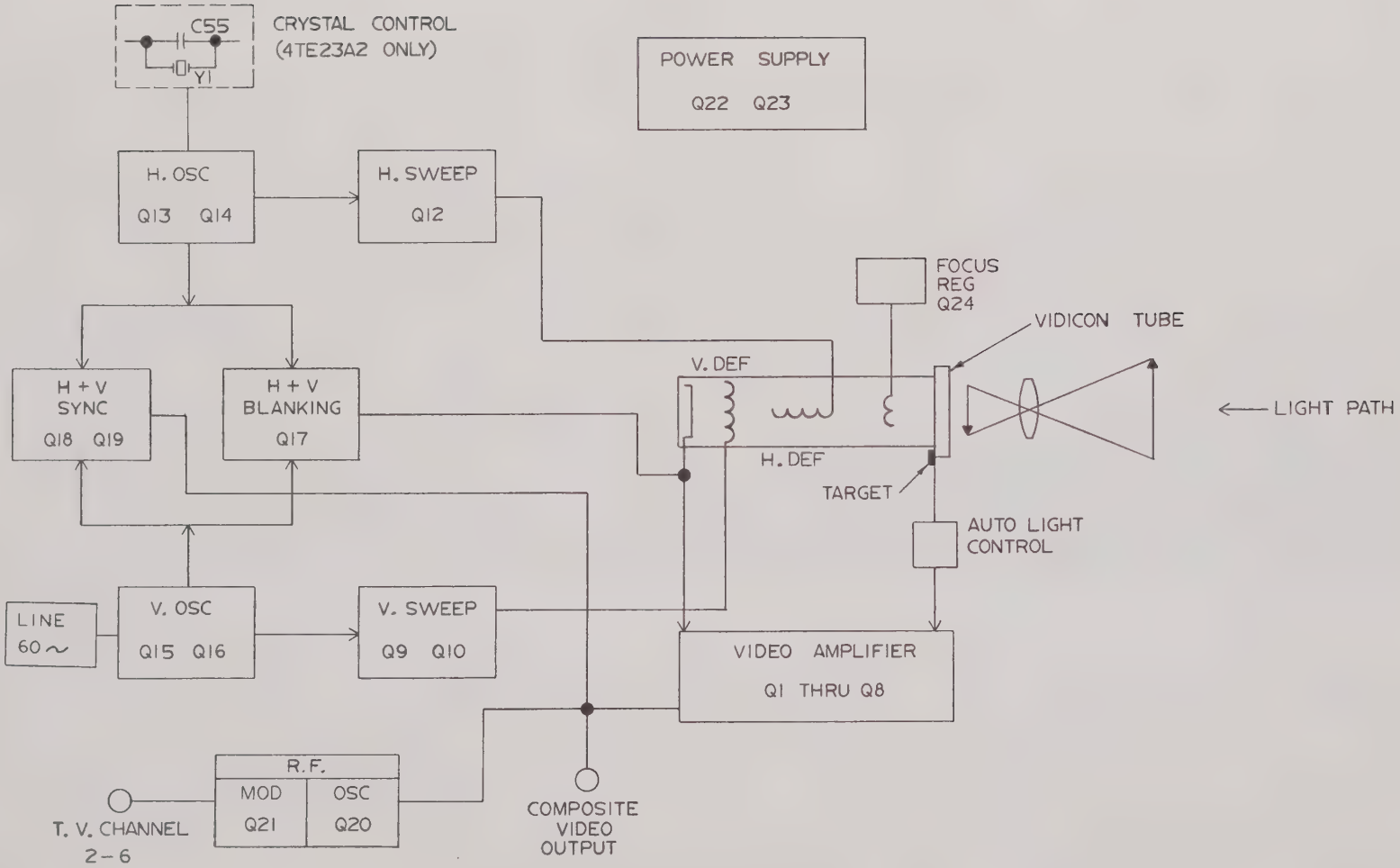
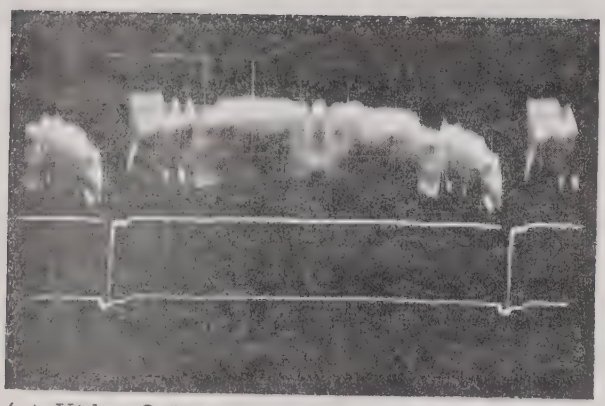
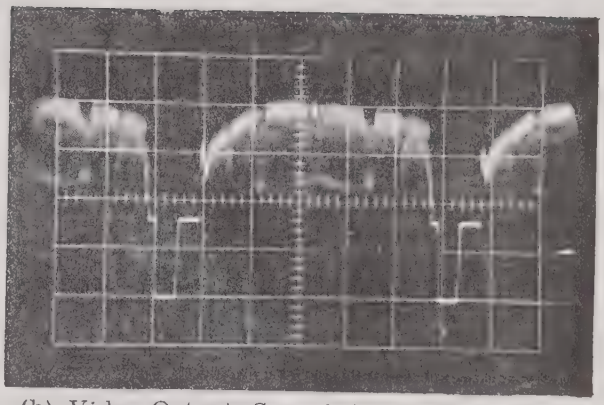


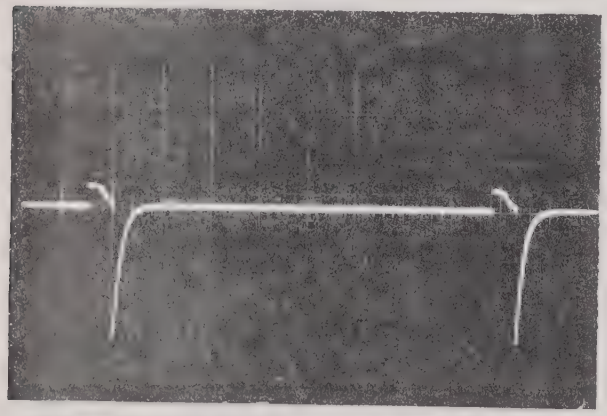
Fig. 2 Block Diagram (B-7399042)



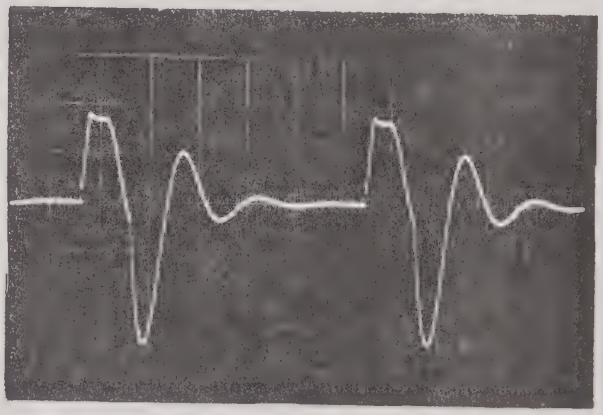
(a) Video Output, Sync 0.4 volt, Video 1.4 volts, P-P, V Rate



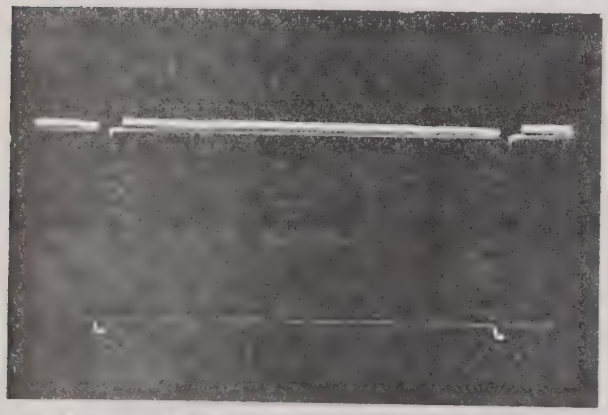
(b) Video Output, Sync 0.4 volt, Video 1.4 volts, P-P, H Rate



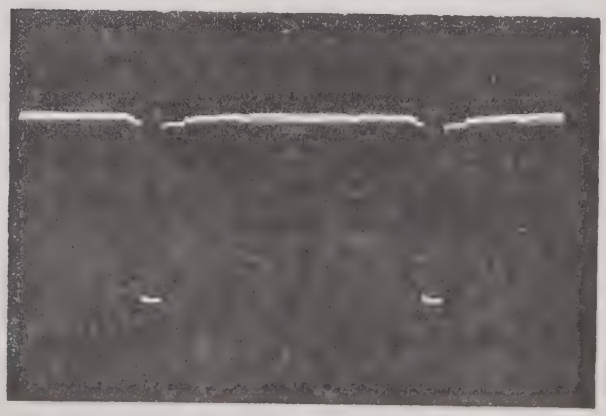
(c) Sync Drive, Q18, Base, 4.0 volts P-P, V Rate



(d) Sync Drive, Q19, Base, 1.5 - 3.0 volts P-P, H Rate



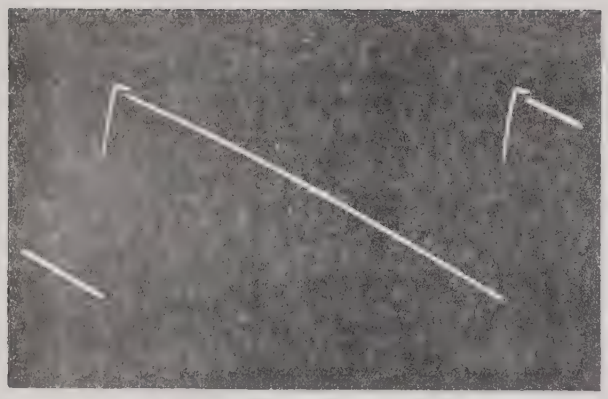
(e) Sync, Q19, Collector, 12 volts P-P, V Rate



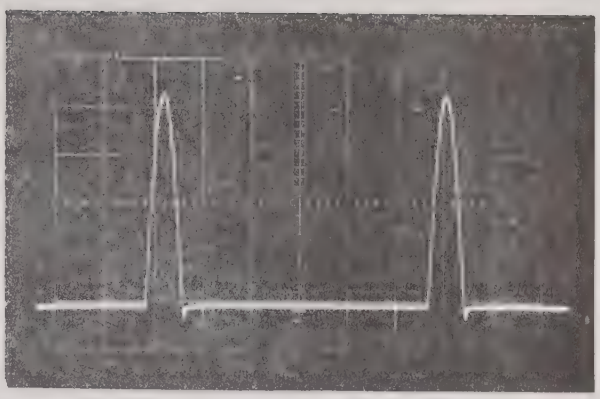
(f) Sync, Q19, Collector, 12 volts P-P, H Rate

The values shown are typical.

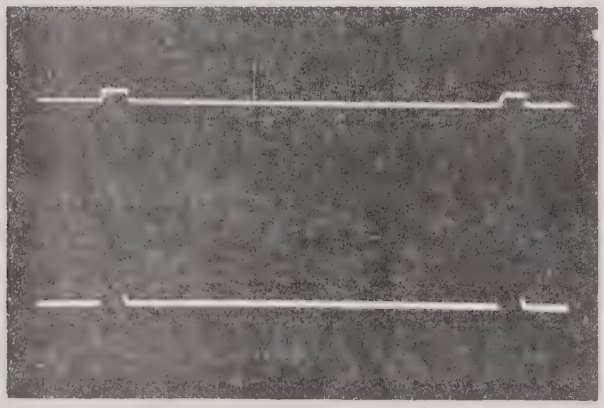
Fig. 3 Waveforms (a-f)



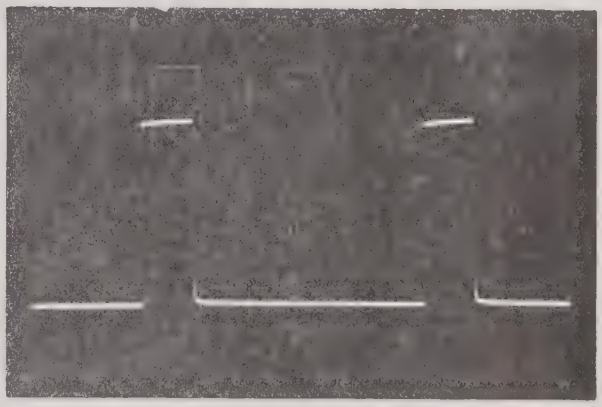
(g) Vertical Sweep, Q10, Emitter, 2.7 volts P-P, V Rate



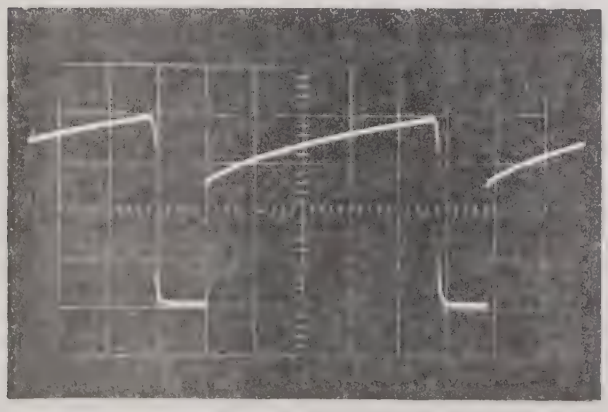
(h) Horizontal Sweep, Q12, Collector, 65 volts P-P, H Rate



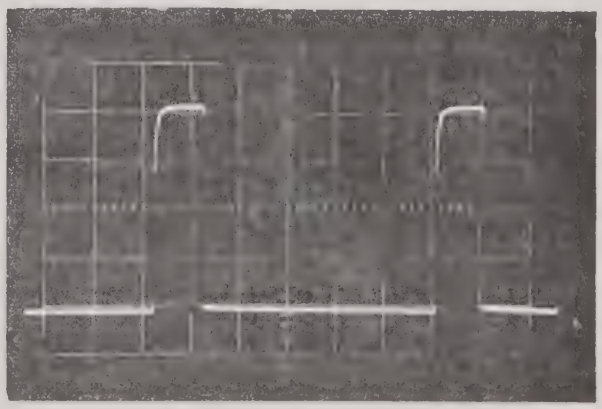
(i) Blanking, Q17, Collector, 24 volts P-P, V Rate



(j) Blanking, Q17, Collector, 24 volts P-P, H Rate



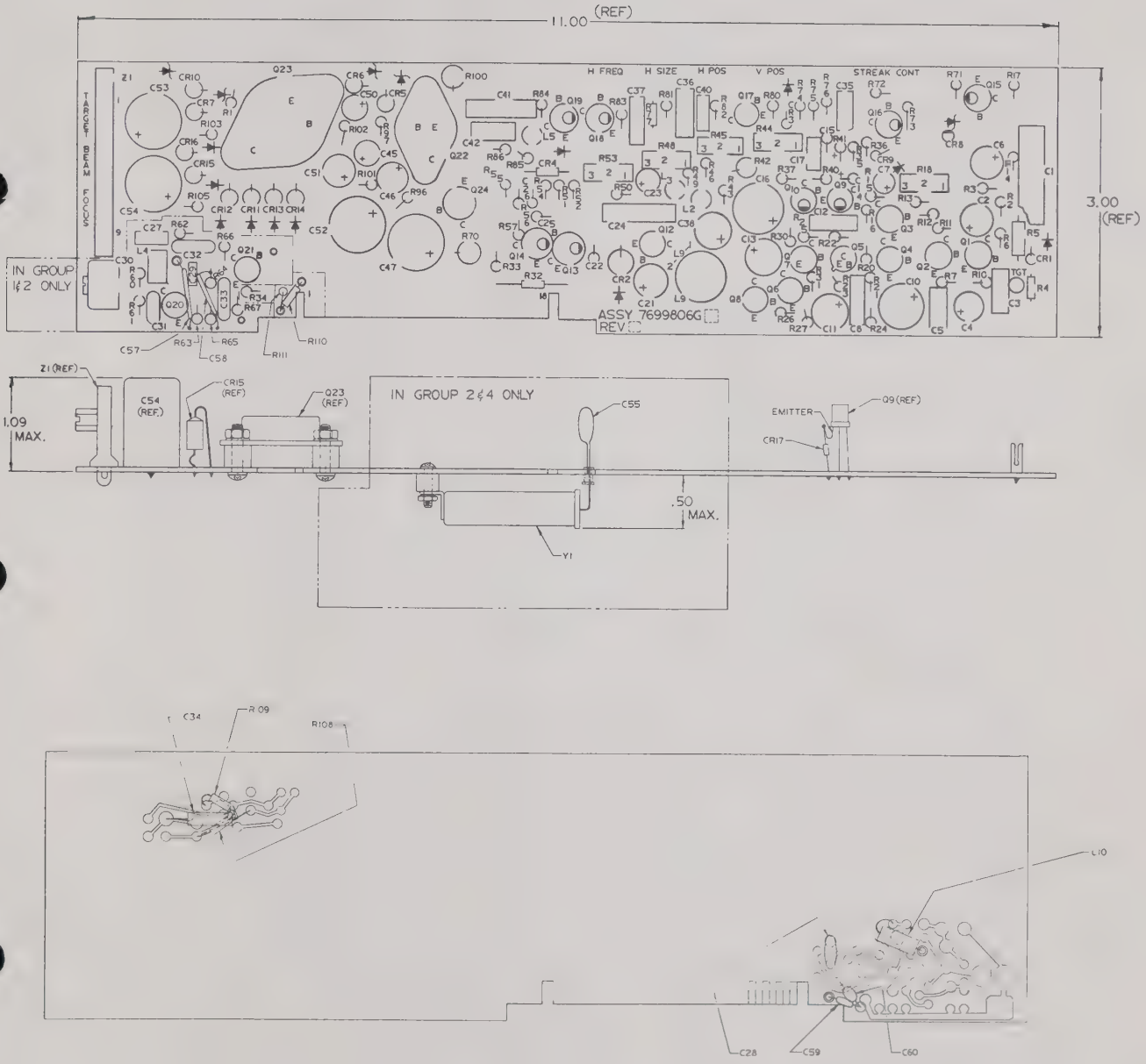
(k) Q13, Collector, 12 volts P-P, H Rate



(l) Q14, Collector, 12 volts P-P, H Rate

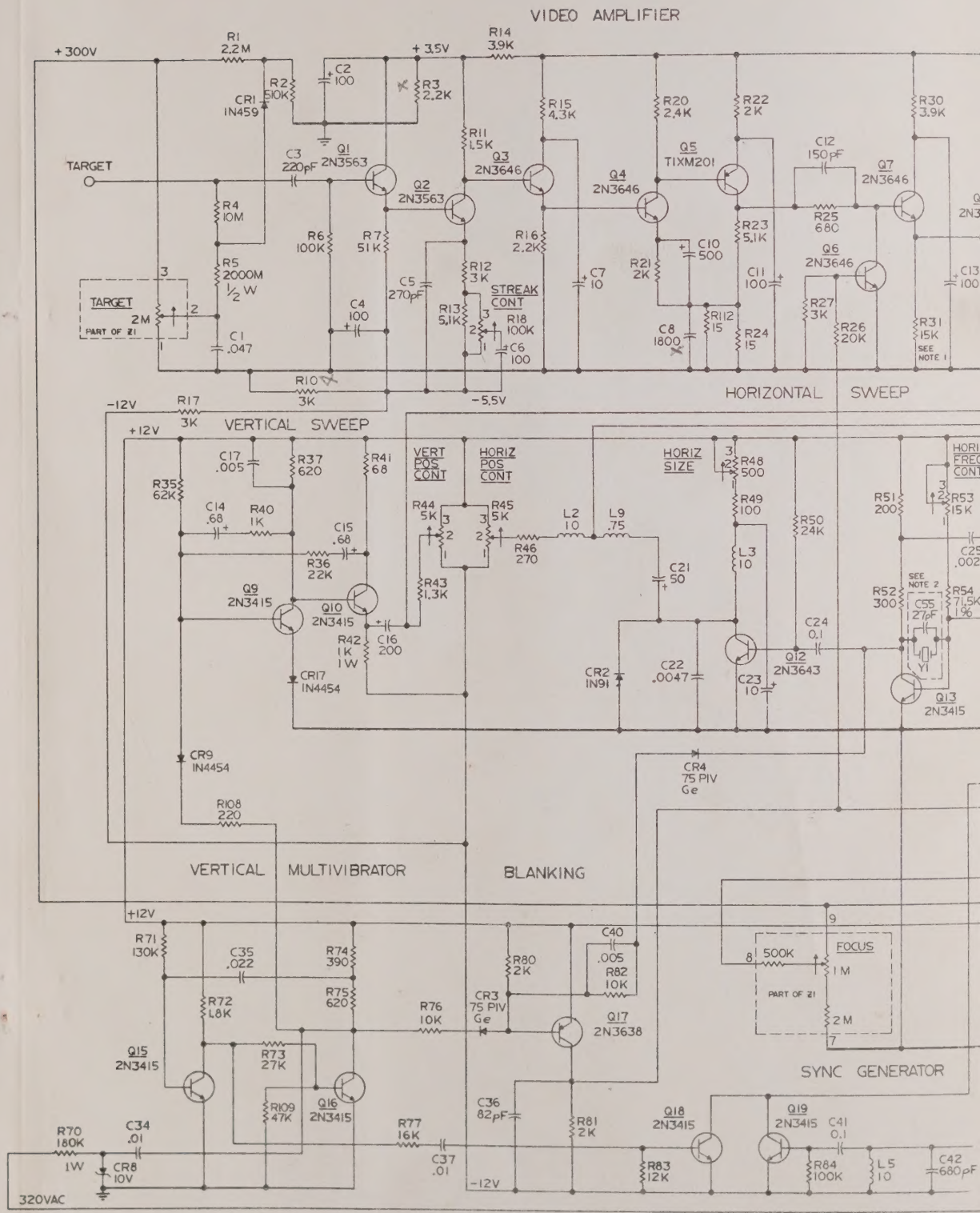
The values shown are typical.

Fig. 4 Waveforms (g-l)



BACK SIDE VIEW FOR COMPONENT LOCATION

Fig. 5 Component Board Layout Diagram (D-7699806, Sheets 1 and 2, Rev. E)


VIDEO AMPLIFIER
+300V
R1 2.2M
R2 510K
CR1 IN459
C2 100
+ 3.5V
R3 2.2K
R14 3.9K
R15 4.3K
R20 2.4K
R22 2K
R30 3.9K
TARGET
C3 220pF
Q1 2N3563
Q2 2N3563
R11 1.5K
Q3 2N3646
Q4 2N3646
Q5 TIXM201
C12 150pF
Q7 2N3646
R25 680
R4 10M
R5 2000M ½ W
TARGET 2M PART OF Z1
C1 .047
R6 100K
R7 51K
C4 100
C5 270pF
R12 3K
R13 5.1K
STREAK CONT
R18 100K
C6 100
R16 2.2K
C7 10
R21 2K
C10 500
R23 5.1K
C11 100
Q6 2N3646
R27 3K
R26 20K
R31 15K SEE NOTE 1
C8 1800
R112 15
R24 15
R10 3K
-5.5V
HORIZONTAL SWEEP
-12V
R17 3K
VERTICAL SWEEP
+12V
C17 .005
R37 620
R41 68
VERT POS CONT
HORIZ POS CONT
HORIZ SIZE
R48 500
R35 62K
C14 .68
R40 1K
C15 .68
R36 22K
R44 5K
R45 5K
L2 10
L9 .75
R46 270
R49 100
R50 24K
R51 200
R53 15K
C21 50
L3 10
R43 1.3K
Q9 2N3415
Q10 2N3415
R42 1K 1W
C16 200
CR17 IN4454
C24 0.1
Q12 2N3643
C23 10
CR2 IN91
C22 .0047
Q13 2N3415
SEE NOTE 2
R52 300
C55 27pF
R54 71.5K 1%
Y1
CR9 IN4454
CR4 75 PIV Ge
R108 220
VERTICAL MULTIVIBRATOR
BLANKING
+12V
R71 130K
C35 .022
R74 390
R72 6.8K
R75 620
R76 10K
R80 2K
C40 .005
R82 10K
CR3 75 PIV Ge
Q17 2N3638
FOCUS
500K
1 M
2 M
PART OF Z1
Q15 2N3415
R73 27K
R109 47K
Q16 2N3415
SYNC GENERATOR
C36 82pF
R81 2K
Q18 2N3415
Q19 2N3415
C41 0.1
R70 180K 1W
C34 .01
CR8 10V
R77 16K
C37 .01
-12V
R83 12K
R84 100K
L5 10
C42 680pF
320VAC

NOTES:

1. WHEN R.F. IS NOT USED, PORTION OF CIRCUIT WITHIN PHANTOM LINES IS OMITTED; R31 VALUE IS 1.2 K
2. WHEN 15.75 KHZ CRYSTAL IS REQUIRED ADD Y1 AND C55.
3. RESISTOR VALUES ARE IN OHMS AND 1/4 WATT UNLESS OTHERWISE SHOWN. K = 1000 OHMS
4. CAPACITOR VALUES ARE IN MICROFARADS UNLESS OTHERWISE SHOWN. pF = PICOFARADS
5. COIL VALUES ARE IN MILLIHENRIES UNLESS OTHERWISE SHOWN. μH = MICROHENRIES

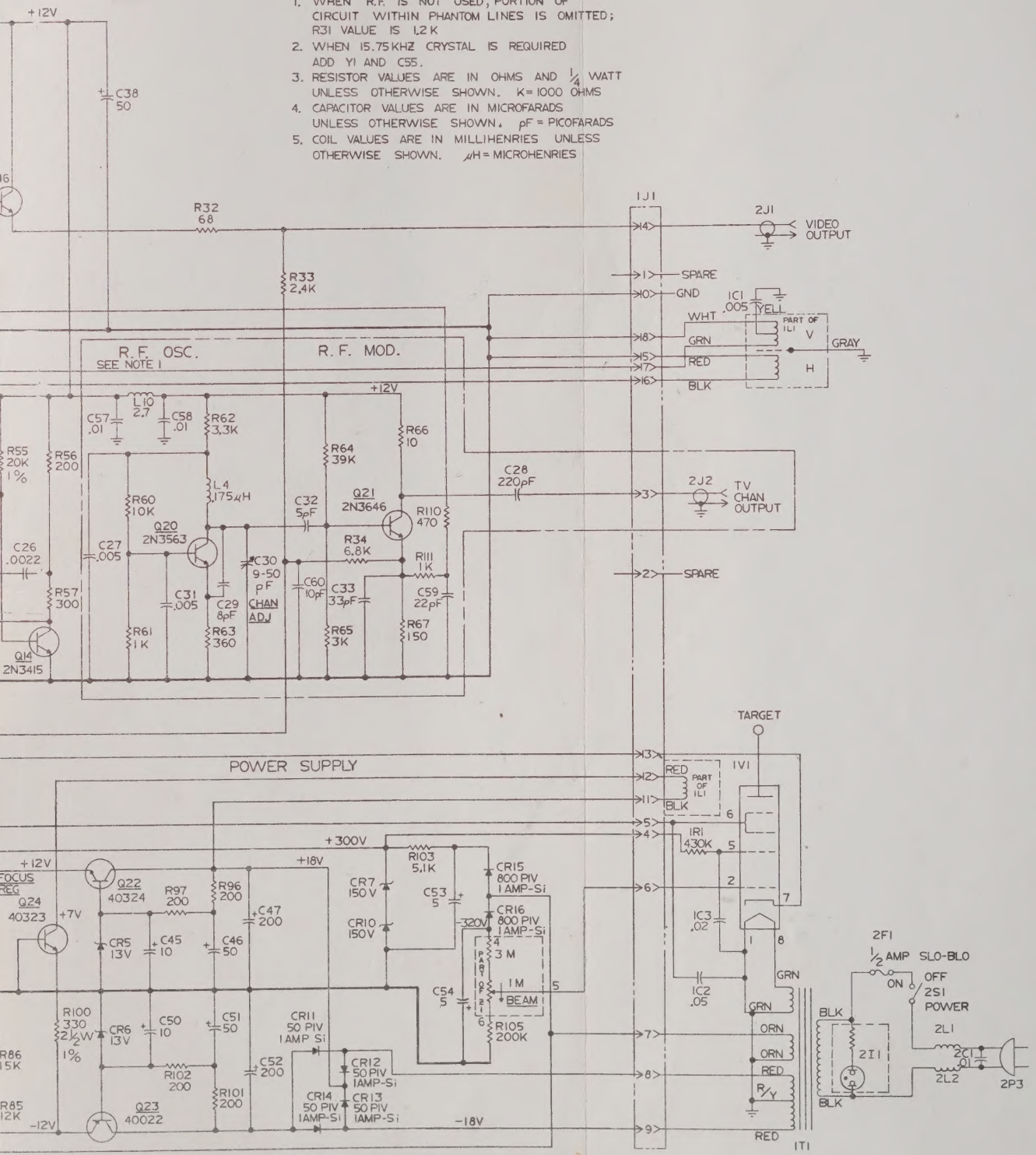


Fig. 6 Schematic Diagram (EE-7354478, Rev. H)

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